SOURCE AND LEVEL OF CRUDE PROTEIN FOR IMPLANTED FINISHING STEERS

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Summary

One hundred medium-framed, crossbred steers (738 lb) were used to compare non-protein nitrogen to natural protein supplementation of finishing diets for implanted steers. Diets were formulated to contain 11.5 or 13.5% crude protein and were supplemented with either urea or soybean meal. A fifth treatment of cottonseed meal supplementation (13.5% dietary crude protein) was added to evaluate differences between natural sources of rumen degradable protein. Steers were implanted with Revalor® and fed for 132 days. During the first 70 days, daily gain and feed efficiency were improved 8.8 and 6.1%, respectively, for steers supplemented with soybean meal vs urea. No difference was observed with protein level. For the entire feeding period, soybean meal increased dry matter intake 3.8% compared to urea. Protein source and level interacted on daily gain. Increasing dietary protein from 11.5 to 13.5% decreased gain by urea-fed steers 8%, whereas increasing dietary protein from 11.5 to 13.5% increased gain 6.1% for steers supplemented with soybean meal. Soybean meal improved feed efficiency 7.6% compared to urea. Protein level had no effect on feed efficiency. Steers supplemented with soybean meal had larger loineye areas than those supplemented with urea. Carcass finish, percentage of carcasses grading Choice, and yield grade were not affected by treatment. Performance and carcass traits of steers fed cottonseed meal were similar to those of steers fed soybean meal. We conclude that urea cannot meet the metabolizable protein needs of implanted finishing steers. Cottonseed meal did not differ from soybean meal as a protein source in this study.

(Key Words: Finishing Steers, Urea, Soybean Meal, Performance.)

Introduction

Growth promotants, especially the combination of estradiol and trenbolone acetate, have the potential to alter nutrient requirements in feedlot steers. Current information concerning requirements of rapidly growing feedlot steers for rumen degradable and metabolizable protein is limited. Soybean meal and urea are two commonly used sources of protein in finishing diets. The usefulness of urea is limited to the amount that provides sufficient rumen ammonia to maximize microbial protein production and(or) rumen organic matter digestion. Other research presented in this publication suggests that, although urea supplementation increases rumen organic matter digestion, it does not enhance protein flow to the small intestine. Conversely, soybean meal contains a degradable protein fraction to supply ammonia, amino acids, peptides, or other growth factors to rumen microbes, as well as an escape fraction to increase true protein reaching the small intestine. Therefore, soybean meal should be better able to increase the supply of metabolizable protein to rapidly growing steers. Our objective was to evaluate two levels of soybean meal and urea on performance and carcass traits of implanted finishing steers.

Experimental Procedures

One hundred medium-framed crossbred steers (738 lb) were stratified by weight into one of four blocks. Within each block, steers were allocated to one of five pens in a 2×2+1 factorially arranged experiment. Diets (Table 1) contained supplemental protein from urea or soybean meal and were formulated to provide 11.5 or 13.5% (dry matter basis) crude protein. A cottonseed meal diet, formulated to provide 13.5% dietary crude protein, was used as an additional treatment to determine differences between the two natural sources of rumen degradable protein. All diets were formulated (dry matter basis) to contain .7% Ca, .35% P, .7% K, 25 g/ton Rumensin®, and 10 g/ton Tylosin®. Initial weights were the averages of two consecutive early morning weights. Steers were implanted with Revalor and stepped up to final rations in 14 days. Steers were fed the experimental diets for 132 days. Hot carcass weights adjusted by a 62% dressing percent were used as final weights for calculation of gain and feed efficiency. Steers were slaughtered at a commercial plant with carcass data being obtained following a 24-hour chill. The statistical analysis allowed comparisons of: 1) level of crude protein, 2) source of crude protein, 3) interaction between level and source of crude protein, and 4) soybean meal vs cottonseed meal at 13.5% dietary protein.

Results and Discussion

During the first 70 days, daily gain ($P<.05$) and feed efficiency ($P<.10$) were improved 8.8 and 6.1%, respectively, for steers supplemented with soybean meal vs urea (Table 2). Despite rapid gains (3.6 to 4.0 lb/day), increasing dietary protein above 11.5% did not improve daily gain or feed efficiency.

Steers supplemented with soybean meal consumed 3.8% more feed ($P=.23$) over the entire feeding period than those supplemented with urea. A level by source interaction ($P<.05$) was observed for daily gain. Daily gain by steers fed urea was decreased 8.0% by increasing supplementation to 13.5% dietary crude protein, whereas gain by steers fed soybean meal increased 6.1% when crude protein levels were increased from 11.5 to 13.5%. Steers supplemented with soybean meal were 7.6% more efficient ($P<.03$) than those supplemented with urea; feed efficiency was not affected by dietary level of crude protein.

The improvement in performance from soybean meal probably was due to improved feed intake, increased metabolizable protein supply, and(or) improvements in fermentation from the provision of rumen degradable amino acids and peptides. Dietary crude protein level and source interacted ($P<.05$) to affect hot carcass weight. As dietary crude protein level from urea increased from 11.5 to 13.5%, hot carcass weight decreased 2.5%, whereas increasing dietary crude protein level from 11.5 to 13.5% with soybean meal increased hot carcass weight 2.4%. Compared to urea, soybean meal supplementation increased ($P<.10$) loineye area, but no effect of dietary protein level was observed. These data suggest that urea-fed steers were deficient in metabolizable protein and that this was at least partially corrected by supplementing with soybean meal. Dressing percentage, fat thickness (12th rib), marbling score, yield grade, and percentage of carcasses grading choice were not affected by treatment.

Results from previous research suggest that urea supplementation serves to enhance organic matter fermentation in the rumen, with little or no increase in metabolizable protein supply to the animal. Improvements in performance and increased carcass weights and loineye areas, with little increase in carcass finish, suggest that supplementing high grain diets with soybean meal increases the total supply of metabolizable protein to the animal. This may be mediated via increased feed intake, increased microbial protein production, or escape of soybean meal protein to the small intestine. Steers fed cottonseed meal had performance and carcass traits similar to those of steers fed soybean meal. Whether benefits from soybean and cottonseed meals result from the degradable

or escape fractions, or a combination of the two, is unclear. However, nonprotein nitrogen evidently cannot meet the metabolizable protein requirement of rapidly growing steers.

Feed cost of gain and economic return to level and source of crude protein are presented in Table 3. Relative to urea, ration costs were increased when soybean meal or cottonseed meal was fed. However, because of improved daily gain and feed efficiency, cost of gain was similar and economic returns were increased when soybean meal or cottonseed meal was fed.

Table 1. Diet Composition (Dry Matter Basis)

Item	Treatment[a]				
	11.5/Urea	13.5/Urea	11.5/SBM	13.5/SBM	13.5/CSM
Rolled corn	85.4	84.6	80.6	76.2	73.1
Prairie hay	8.0	8.0	8.0	8.0	8.0
Soybean meal[b]	--	--	6.2	10.7	--
Cottonseed meal[b]	--	--	--	--	13.7
Urea	.93	1.58	--	--	--
Vitamins, minerals, and additives[c]	3.2	3.3	2.7	2.6	2.7
Molasses	2.5	2.5	2.5	2.5	2.5

[a]Dietary treatments (% crude protein/source). SBM = soybean meal; CSM = cottonseed meal.

[b]Soybean meal and cottonseed meal contained (as-fed basis) 48 and 41% crude protein, respectively.

[c]To provide dietary levels of 1500 IU/lb Vitamin A, 20 IU/lb Vitamin E, .7% Ca, .35% P, .7% K, 25 g/ton Rumensin®, and 10 g/ton Tylosin®.

Table 2. Effect of Level and Source of Crude Protein on Performance and Carcass Traits of Implanted Finishing Steers

	Treatment [a]					
Item	11.5/Urea	13.5/Urea	11.5/SBM	13.5/SBM	13.5/CSM	SEM
No. pens	4	4	4	4	4	
No. steers	20	20	20	20	20	
Initial wt, lb	736	740	738	739	739	1.8
Final wt[b], lb	1147	1118	1168	1197	1198	12.8
Day 0-70						
Daily feed, lb	21.76	21.28	22.08	22.13	23.39	.58
Daily gain[c], lb	3.64	3.61	3.89	4.07	3.95	.14
Feed/gain[d,e]	6.01	5.89	5.73	5.46	5.95	.21
Day 0-132						
Daily feed, lb	21.66	20.56	21.78	22.09	22.80	.65
Daily gain[f], lb	3.11[h]	2.86[i]	3.25[hj]	3.46[j]	3.47[j]	.09
Feed/gain[c,e]	6.98	7.19	6.72	6.37	6.59	.21
Carcass Traits						
Hot carcass wt[f], lb	711[h]	693[hi]	724[hj]	742[j]	743[j]	7.9
Dressing %	62.0	60.4	61.3	61.2	61.9	.54
Fat 12th rib, in	.46	.41	.44	.49	.48	.03
KPH, %	2.43	2.30	2.38	2.42	2.48	.08
Loineye area[d], sq in	13.9	13.9	14.3	14.9	15.2	.37
Marbling score[g]	5.21	5.04	5.17	5.31	5.17	.16
Yield grade	2.38	2.16	2.26	2.24	2.16	.13
Percent choice	70	70	85	85	80	

[a]Dietary treatments (% crude protein/source) SBM = soybean meal; CSM = cottonseed meal.
[b]Final wt = Hot carcass wt÷.62.
[c]Urea vs soybean meal (P<.05).
[d]Urea vs soybean meal (P<.10).
[e]Feed/gain was analyzed as gain/feed and reported as the reciprocal.
[f]Crude protein level by protein source interaction (P<.05).
[g]4 = slight, 5 = small, 6 = modest.
[hij]Means in a row lacking a common superscript differ (P<.10).

Table 3. Effect of Level and Source of Crude P r otein on Economic Return in Implanted Finishing Steers

	Treatment				
Item	11.5/Urea	13.5/Urea	11.5/SBM	13.5/SBM	13.5/CSM
Ration cost, $/ton [a]	103.20	104.00	109.52	114.66	115.74
Ration cost, $/head	148.21	141.12	157.43	167.17	174.17
Yardage and interest [b]	46.20	46.20	46.20	46.20	46.20
Feed cost of gain, $/lb	.360	.373	.368	.365	.381
Cost of gain. $/lb	.472	.495	.474	.466	.480
Economic return, live basis [c]					
Income, $/head	837.31	816.14	852.64	873.81	874.54
Cost, $/head [d]	822.05	816.99	831.27	841.01	848.01
Return, $/head	15.26	4.15	21.37	32.80	26.53

[a]Urea = $220/ton, soybean meal = $220/ton, cottonseed meal = $205/ton.
[b]Calculated $.35 /head/day.
[c]Cash price $73.00 per cwt.
[d]Initial cost $85.00 per cwt.